The PPPL Highlights for the week ending November 13, 2015 are as follows:

**U.S. ITER FABRICATION (C. NEUMEYER):**

**Steady State Electric Network (SSEN):**

Award of a subcontract for the Reactive Power Compensators procurement required additional iterations but a version acceptable to all parties has now been developed and the contract is now in the signature process.

All of the Release for Manufacturing (RFM) documents have now been uploaded to the ITER Document Management (IDM) system and all have been approved except for one. A change order letter was received from the supplier reflecting the various changes that evolved during the design review process. A requisition was submitted to initiate a contract amendment to cover the change order. Once the last RFM chapter is approved and the contract amendment is signed, the RFM will be approved.

**Diagnostics:**

Upper Port Wide Angle View Visible-IR Camera (UPP WAVs): M. Smith traveled to General Atomics in San Diego for a three day technical peer review on the Upper Port Wide Angle View Visible-IR camera project along with engineers from the Dutch company TNO and technical staff from Lawrence Livermore National Lab.

Motional Stark Effect (MSE): The use of the Attila neutronics code on ITER is a great resource for quick and timely neutronics analysis. But due to the complexity of the project, and as we approach the project completion, the neutronics models have been becoming more and more complex. Currently there is work being done on a method to use the Attila neutronics code as a multi-model analysis code that will take a solution from an initial large and complex model and apply it to a secondary sub-model. The most urgent need for this is in the Port Cell rooms which are on the outside of the Bio-Shield Wall. The C-Lite global ITER model provides the neutron and gamma flux solution on the Inner Bio-Shield Wall. This will be turned in to a boundary source for a separate Port Cell sub-model.

Core Imaging X-Ray Spectrometer (CIXS): A test plan document was completed for nuclear testing of a Pilatus 100K detector. The test will aim to determine if current x-ray detectors are capable of handling the radiation loads expected at ITER. Also a test plan document was finished for the magnetic field testing that will determine whether the x-ray detectors are capable of handling the magnetic fields at ITER. Lastly, designs are underway for supporting structures to
allow the magnetic field testing to be completed.

**Low Field Side Reflectometer (LFSR):** A number of designs were reviewed for creating a SIC2 penetration through the bio-shield plug in equatorial port # 11. This penetration must maintain alignment of microwave waveguides, provide a SIC2 barrier, and allow for movement of the building relative to the waveguide. A design path was chosen and 3D modeling will begin shortly on the new design.

**NSTX (M. ONO):**

F. Poli (PPPL) traveled to Argonne National Laboratory, November 4-6, to attend the first Summit of Women Scientists and Engineers in the DOE laboratories. About 30 female scientists and engineers from the 17 National Laboratories were invited to attend the meeting, which was sponsored by COACh (University of Oregon) funding from the DOE. The meeting sought to engage women in STEM (Science, Technology, Engineering and Math) in the DOE research complex to discuss ongoing efforts by Leadership and employees to promote inclusiveness and enable creative, productive environments which maximize the potential of all researchers to serve the nation’s interests. The purpose of this summit was to share challenges and best practices on broadening gender representation and diversity in our institutions, and identify persisting issues in the National Lab environment that prevent increased hiring and retention of women in STEM, with the desired outcome of formulating recommendations and action plans for individual researchers, laboratory management, and DOE. The Summit was also an opportunity for women scientists and engineers from the DOE laboratories to network with each other and discuss strategies to improve the success and leadership stature of women scientists and engineers across the DOE complex.

The main mechanical and electrical installation tasks have been completed for the Materials Analysis and Particle Probe (MAPP). Felipe Bedoya, a doctoral student from the University of Illinois at Urbana-Champaign, has been at PPPL during the two weeks. He insured that the final connections between the MAPP electronics rack and instrument chamber on NSTX-U were made, and checked the programs (LabVIEW VI’s) required for MAPP remote control during plasma operations. This includes heater control and thermocouple monitoring for thermal desorption spectroscopy (TDS) and electrostatic analyzer and detector operation for X-ray photoelectron spectroscopy (XPS).

NSTX-U Field Coil Power testing began this past week after completing a full set of field coil electrical insulation tests (Hi-Pots), and polarity checks of the Resistive Wall Mode (RWM) coils. The integrated system testing of the RWM coils as powered by the Switching Power Amplifier (SPA) systems has been completed, as well as comprehensive checks of the RWM sensors and magnetic diagnostics. Conditioning of the neutral beam ion sources was performed in parallel with field coil power testing. Leak checking for small air leaks continues in the upper and lower umbrellas.
ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

Testing of the upgraded LGI system was performed this week with carbon granules. The granules were launched into an aluminum foil target and the granule alignment to the impeller was optimized using the new drop tube movement device without breaking vacuum. The impeller speed control was tested successfully using the new electric motors with precise speed control. In addition boron granules with 99.999% purity were ordered and will be smoothed using a tumbler in hopes of using these in the next LGI run scheduled for January, along with lithium and carbon granules.

A. Nagy presented at a CDR on the High Power Helicon system covering the power power supplies for the Klystrons. Highlights include utilization of the existing FMIT coax transmission line and dummy load, and a vacuum strip line design using the old Fast Wave antenna feedthroughs.

R. Nazikian and R. Maingi attended a meeting at OFES to discuss the output of the three community workshops held earlier in the year.

ADVANCED PROJECTS (H. NEILSON):

The Laboratory is leading the final phases of a project to design and fabricate a TDU Scraper Element for the Wendelstein 7-X (W7-X) stellarator, in collaboration with Oak Ridge National Laboratory and Germany’s Max Planck Institute for Plasma Physics (IPP). The week of November 9, an important milestone was achieved with the successful completion, pending resolution of minor chits, of a final design review for the project. The review team was co-chaired by senior PPPL and IPP engineers, and included participants from both institutions as well as from ORNL, who led the initial phases of the project. At the review, PPPL and IPP project participants recapitulated the project requirements and described the design, supporting analysis and tests, and plans for completing the project. The plans call for fabrication of the two major the sub-components to be performed by commercial suppliers using material furnished by the project. In addition, test articles will be provided to IPP for thermal testing and installation mockup. An updated resources-loaded plan was presented, showing that U.S. deliverables could be completed within the remaining budget and schedule, and well before W7-X need dates.

THEORY (A. BHATTACHARJEE):

C. S. Chang and D. Stotler attended the inaugural workshop on Sensitivity, Error and Uncertainty Quantification for Atomic, Plasma, and Material Data at Stony Brook University, November 7-8. Chang presented a talk entitled "Telescoping UQ Method for Extreme Scale Kinetic Simulation of Magnetic Fusion Plasma". Stotler served as a member of the workshop's Scientific Committee.

On November 12, C.Z. Cheng (University of Tokyo) presented a theory seminar on plasma dynamics and heating/acceleration during driven magnetic reconnection: Highlights of the
plasma dynamics and energization during driven anti-parallel magnetic reconnection are presented. The MHD condition breaks down in the entire reconnection layer (the reconnection current layer, the separatrix region and the whole downstream), and the plasma dynamics is significantly different from the results of the Hall-MHD model. In particular, we explain (1) how electron and ion dynamics decouple and how the charge separation and electrostatic electric field are produced in the magnetic field reversal region (reconnection current layer and outflow exhaust) and around the separatrix regions, (2) how electrons and ions gain energy in the reconnection current layer, (3) why the electron outflow velocity in the reconnection exhaust reaches super-Alfvenic speed and the ion outflow velocity reaches Alfvenic speed and how the parallel electric field is produced, (4) how electrons are accelerated by the parallel electric field around the separatrix region, and (5) how ions gain energy when they move across the separatrix region into the downstream. Also, we will show how electrons and ions gain energy mainly from the inductive reconnection driven electric field and less from the electrostatic electric field.

On November 12, Josh Burby (Courant Institute, NYU) presented a theory seminar on rescuing phase space in high-order variational drift kinetics: He will argue that existing high-order variational drift kinetic theories contain unphysical rapidly varying modes that are not seen at low-orders. These unphysical modes, which may be rapidly oscillating, damped, or growing, are ushered in by a failure of conventional high-order drift kinetic theory to preserve the structure of its parent model's initial value problem (Vlasov-Poisson for electrostatics, Vlasov-Darwin or Vlasov-Maxwell for electromagnetics.) In short, the system phase space is unphysically enlarged in high-order variational drift kinetic theory. He also presented an alternative, “renormalized” variational approach to drift kinetic theory that manifestly respects the parent model's initial value problem. The basic philosophy underlying this alternate approach is that high-order drift kinetic theory ought to be derived by truncating the all-orders system phase space Lagrangian instead of the usual “field+particle” Lagrangian. For the sake of clarity, this story will be told mainly through the lens of a finite-dimensional toy model of high-order variational drift kinetics; the analogous full-on drift kinetic results will be summarized near the end of the talk.

On November 13, Steve Cowley (Culham) presented a theory seminar on nonlinear ballooning and disruptions: Internal transport barriers (ITBs) exhibit extremely fast disruptions. ECE data from TFTR showed that these disruptions are often a result of the triggering of ballooning modes. He discussed recent work at Culham on nonlinear ballooning instabilities and the dynamics of highly elliptical flux tubes in tokamaks. For some ITB profiles that are everywhere stable to linear ballooning modes a state with highly displaced elliptical flux tubes has a lower energy than the axisymmetric state. The triggering and timescales to erupt into these states will be discussed.

ENGINEERING AND INFRASTRUCTURE (L. DUDEK):

Mechanical Engineering Division (D. Loesser):

On November 11, a successful FDR for W7-X TDU-SE scraper project was held. A few category 3 CHITS will be addressed prior to beginning fabrication activities.
M. Zarnstorff attended the National Laboratory CRO (Chief Research Officer) meeting on November 9-10 in Washington, DC.

On November 12, Dr. Thomas Sunn Pedersen, from the Max Planck Institute of Plasma Physics, presented a colloquium entitled “W7-X Status Report”.

The bi-annual PPPL Advisory Committee meeting was held at PPPL on November 11-12. The purpose of the PPPL Advisory Committee is to review the efficiency and effectiveness of the Laboratory science and operations.

This report is also available on the following web site:
http://www.pppl.gov/publication-type/weekly-highlights